Gastrointest Interv 2015; 4:55–57

Contents lists available at ScienceDirect

Gastrointestinal Intervention

journal homepage: www.gi-intervention.org

Case Report

Spontaneous circulation return after termination of resuscitation efforts for cardiac arrest following embolization of a ruptured common hepatic artery pseudoaneurysm

Zachary Wilseck,[1,*] Kyung Cho[2]

A B S T R A C T

Return of spontaneous circulation after termination of resuscitation attempts for cardiac arrest is an extremely rare event. Here we describe an unusual case of a 50-year-old man with massive upper gastrointestinal bleeding from a ruptured common hepatic artery pseudoaneurysm who survived after termination of resuscitation attempts for cardiac arrest during coil embolization. One month earlier, he had undergone total gastrectomy and Roux-en-Y esophagojejunostomy secondary to Stage IV gastric adenocarcinoma. Immediately after the deployment of a Nester coil in the common hepatic artery at the site of a pseudoaneurysm, he sustained cardiopulmonary arrest. After 30 minutes of resuscitation attempts, he died. Approximately 2 minutes after he was pronounced dead, his spontaneous cardiopulmonary circulation resumed. After placement of additional coils in the common hepatic artery, he fully recovered without neurologic disability.

Keywords: common hepatic artery, embolization, Lazarus phenomenon, pseudoaneurysm

Introduction

Resumption of cardiopulmonary function following pronouncement of death is very uncommon. Thirty-eight such cases have been documented in the literature of the Lazarus phenomenon or delayed return of spontaneous circulation (ROSC).[1] Previously published cases have shown that auto-positive end expiratory pressure (auto-PEEP) and impaired venous return account for a majority of ROSC. To the best of our knowledge, we describe the first case of ROSC that occurred during transcatheter embolization of massive gastrointestinal (GI) bleeding from a ruptured pseudoaneurysm of the common hepatic artery.

Case report

A 50-year-old man presented to an outside hospital with a 3-day history of abdominal pain and constipation. His surgical history was significant for a total gastrectomy with a Roux-en-Y esophagojejunostomy and jejunostomy tube placement for a gastric antral adenocarcinoma (T4aN1MO) previously. He had one episode of significant hematemesis on the day of presentation. Contrast-enhanced computed tomography (CT) scans showed a 1.1-cm-diameter hyperdense focus at the anterior aspect of the common hepatic artery (Fig. 1A). At that time he became hypotensive with a systolic blood pressure of 80–90 mmHg and received 7 L of crystalloid resuscitation. He was then transferred to the University of Michigan Health System. Upon arrival at the University of Michigan emergency department, he was hemodynamically stable without respiratory compromise. During attempted Esophagogastroduodenoscopy to identify the source of bleeding, he developed extensive hematemesis that led to hemorrhagic shock and required intubation. He was transfused with 25 units of packed red blood cells, as well as fresh frozen platelets and other blood products and was hemodynamically stable at that point. He underwent emergent angiography for the diagnosis and treatment of massive upper GI bleeding.

After access to the right common femoral artery was gained, a visceral catheter was advanced and positioned in the superior mesenteric artery. A superior mesenteric angiogram was performed that demonstrated diffuse mesenteric vasoconstriction (Fig. 1B). A CO_2 superior mesenteric angiogram was performed with the injection of 20 mL of CO_2 using the plastic bag delivery system, which demonstrated a celiacomesenteric trunk and a pseudoaneurysm arising from the common hepatic artery (Fig. 1C). Repeat superior mesenteric angiogram was performed more proximally and at a higher injection rate using contrast medium. This allowed visualization of the celiac artery and its branches as well as an extravasating pseudoaneurysm (Fig. 1D). A 3F microcatheter (Renegade STC with an angled tip; Boston Scientific, Marlborough,

[1] Michigan State University College of Human Medicine, East Lansing, MI, USA
[2] Department of Radiology, University of Michigan Health System, Ann Arbor, MI, USA
Received 17 November 2014; Revised 2 January 2015; Accepted 16 January 2015
* Corresponding author. Michigan State University College of Human Medicine, East Lansing, 508 Lafayette Avenue SE, Grand Rapids, MI 49503, USA.
E-mail address: wilseckz@msu.edu (Z. Wilseck).

http://dx.doi.org/10.1016/j.gii.2015.01.002

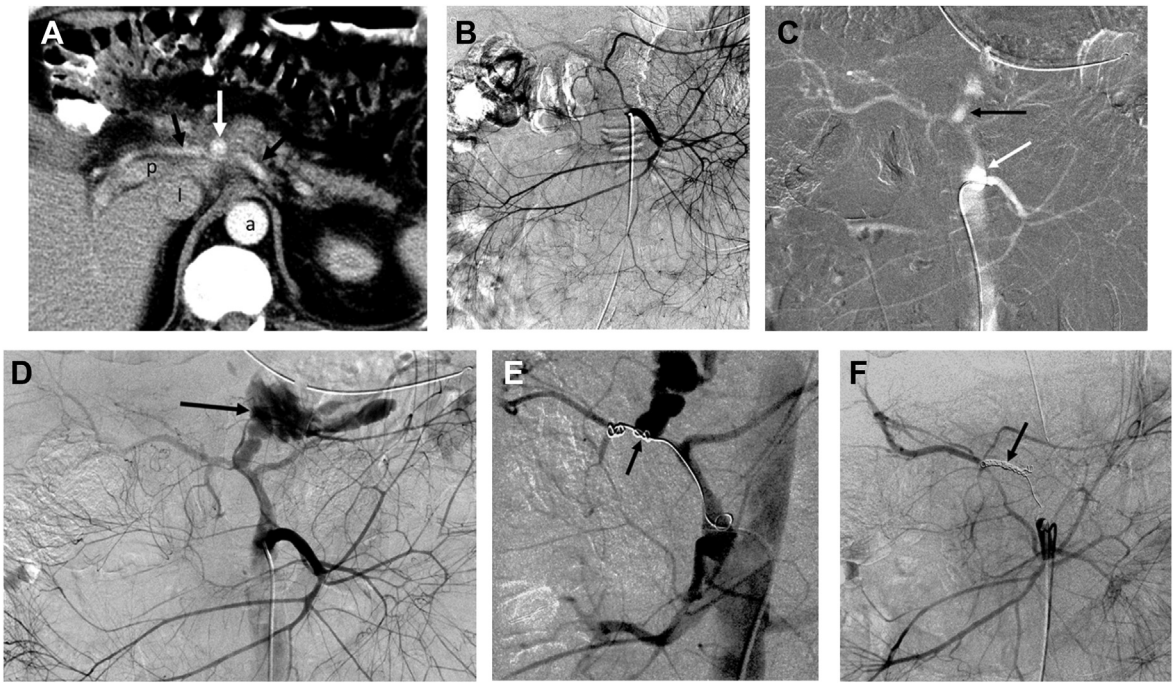

Fig. 1. Ruptured common hepatic artery pseudoaneurysm with massive hematemesis in a 50-year-old man with a history of total gastrectomy with Roux-en-Y esophagojejunostomy for gastric adenocarcinoma. (A) Computed tomography section through the pancreas after intravenous injection of contrast material showing a 1.1-cm-diameter, hyperdense focus (white arrow) at the anterior aspect of the common hepatic artery (black arrows). (B) Digital subtraction superior mesenteric arteriogram (arterial phase) showing diffuse narrowing of the mesenteric artery branches secondary to hypovolemic hypotension. (C) CO_2 superior mesenteric arteriogram showing a celiacomesenteric trunk (white arrow) and extravasation from a common hepatic artery pseudoaneurysm (black arrow). (D) Repeat superior mesenteric arteriogram with the injection of contrast medium more proximally and at a higher injection rate showing filling of the celiac artery and massive extravasation from the common hepatic artery pseudoaneurysm into the Roux-en-Y loop and then into the esophagus (arrow). (E) After deployment of a 6 mm × 14 cm Nester coil in the common hepatic artery distal and proximal to the pseudoaneurysm using a 3F Renegade STC microcatheter, arteriogram shows persistent extravasation. The proximal part of the coil was inadvertently deployed into the celiac axis. Prior to deployment of a second coil, the patient developed cardiac arrest. Two minutes after a termination of unsuccessful chest compression that had lasted 30 minutes, the patient's spontaneous cardiopulmonary circulation returned. (F) Deployment of additional Tornado microcoils in the common hepatic artery resulted in occlusion of the common hepatic artery and pseudoaneurysm with arrest of the bleeding (arrow). The hepatic artery reconstitutes through the pancreatic arcade arteries from the superior mesenteric artery. a, aorta; I, inferior vena cava; p, portal vein.

MA, USA) was advanced coaxially into the common hepatic artery and a digital subtraction angiography again revealed massive extravasation from a 1.1-cm pseudoaneurysm of the common hepatic artery. A 0.018-inch 6 mm × 14 cm Nester coil (Cook Inc., Bloomington, IN, USA) was deployed from the bifurcation of the common hepatic artery toward its origin of the celiac axis. The proximal portion of the coil was inadvertently extended to the celiac axis (Fig. 1E). Prior to the deployment of the second coil to complete coil occlusion of the gastroduodenal artery, the patient developed cardiac arrest and lost consciousness. Cardiopulmonary resuscitation (CPR) was immediately started. Just prior to cardiac arrest, the patient's systolic blood pressure had declined from 100 to 60 mmHg. The code team was called, the catheter was removed, and CPR was then initiated. After 30 minutes of resuscitation without response, the decision was made to halt resuscitation and extubate the patient. Before the femoral access sheath could be removed, approximately 2 minutes had passed during which the patient remained asytolic and without identifiable blood pressures. After 2 minutes of asystole and absent blood pressures, the patient spontaneously developed a sustainable pulse. He was reintubated, and the procedure was completed with the placement of a second 0.018-inch 4 mm × 2 cm Nester coil and three 4 mm × 2 cm Tornado coils (Cook Inc.). A completion arteriogram showed complete occlusion of the hepatic artery (Fig. 1F). The superior mesenteric artery was patent and provided collateral circulation to the hepatic artery through the pancreatic arcade and gastroduodenal artery. The bleeding common hepatic artery was completely occluded without evidence of further extravasation.

After the procedure, the patient was taken to the surgical intensive care unit and proceeded to recover over the remainder of his hospitalization. The only complication during his postoperative course was a short-term memory loss. The neurology service was consulted and determined that this would improve with time and was not organic in nature. Because of what was presumed to be a duodenal stump leak, the patient was maintained on empiric antibiotics and did not develop signs of infection. The patient remained stable from a cardiovascular, pulmonary, and GI perspective. The patient did not have any repeat episodes of hematemesis and was discharged 11 days after the embolization. He had not had recurrent bleeding or mental disability. He died of recurrent cancer 8 months after the embolization.

Discussion

We present in this article a unique case of delayed ROSC occurring 2 minutes after termination of resuscitation efforts during the embolization of a bleeding common hepatic artery pseudoaneurysm.

Massive extravasation due to aneurysmal rupture is a dangerous complication of pseudoaneurysms.[2] Management includes rapid resuscitation initiation to correct for hemodynamic instability and provision of additional time for diagnostic and therapeutic management, as well as decreased mortality risk.[3] A pseudoaneurysm may occur in four distinct circumstances: (1) iatrogenically following catheterization of the vessel; (2) following anastomosis of a native vessel with synthetic graft; (3) trauma; (4) infection.[4]

Hepatic artery aneurysms occur frequently in the common hepatic artery (65%).[2]

The embolization of bleeding pseudoaneurysms can control GI bleeding and act as a lifesaving procedure. Although treatment can be successful, one must be mindful of the occurrence of delayed ROSC, and consensus among the medical team must be achieved for pronouncement of death. Delayed ROSC was first documented in the literature in 1982 and coined the Lazarus phenomenon in 1993.[1] The literature recommends observing patients for at least 10 minutes with blood pressure and electrocardiographic monitoring after cessation of CPR.[1] The decision to terminate resuscitative efforts rests on the treating physician. There are many factors that must be taken into account including time to CPR, prearrest state, comorbidities, and whether ROSC occurs during these efforts.[5] In the case presented above, the patient had significant preexisting comorbidities, 30 minutes of CPR, but did not experience ROSC during resuscitation efforts. The importance of CPR cannot be overstated, but in the presence of acute GI bleeding, resuscitation can lead to further extravasation.

The primary diagnostic procedure in hemodynamically stable patients with massive upper GI bleeding should be endoscopy. Diagnostic angiography should be performed when endoscopy fails to reveal the bleeding site. Although direct catheter angiography is considered the gold standard for diagnosis, the use of multidetector computed tomography can lead to quick and accurate imaging without invasive measures. Multidetector computed tomography should only be used when patients are hemodynamically stable and do not have contraindications to the technique.[6] Even when the bleeding site has been identified by endoscopy but fails to respond to endoscopic intervention, the patient is generally referred for angiography.

The importance of pseudoaneurysm treatment is apparent. There are several strategies currently used to treat this complication. These strategies include minimally invasive percutaneous treatments, such as coil embolization, insertion of covered stents, or thrombin injection. Other strategies available are surgical repair or ultrasound-guided compression repair.[7] Endovascular coils are most commonly used for treatment of massive extravasation from a ruptured pseudoaneurysm of the hepatic artery. In the presented case, despite massive extravasation from a ruptured pseudoaneurysm, the patient survived after termination of resuscitation efforts. This could be attributed to cessation of the bleeding from thrombosis of the feeding common hepatic artery. The thrombosis occurred despite the incomplete occlusion of the common hepatic artery following the placement of a single coil just prior to cardiac arrest.

The diagnosis of upper GI bleeding in this case was made owing to the use of CO_2 gas and its significant intrinsic properties as a contrast agent. Beginning in the 1970s, carbon dioxide gas has been used as a contrast agent in intra-arterial angiography. There is little or no nephrotoxicity with the use of carbon dioxide gas as a contrast agent.[8] CO_2 angiography has been shown to be useful in settings requiring treatment of bleeding, arteriovenous fistulas, and pseudoaneurysm.[9] Owing to the high-solubility rate of CO_2, even if a gas bubble "blocks" a vascular bed, the effects are transient. Other than the proven safety of CO_2, the physical properties between CO_2 gas and iodinated contrast differ. In blood, iodinated contrast mixes whereas CO_2 displaces the blood within the vasculature.[9] Owing to the buoyancy of CO_2 gas, in this case we were able to visualize the celiacomesenteric artery, which led to the successful treatment of the common hepatic artery pseudoaneurysm. Without the use of CO_2 gas, embolization of the ruptured pseudoaneurysm may not have been possible or performed in a timely manner. Ultimately, through rapid resuscitation, angiography, and endovascular coil embolization, the patient presented in the case above was able to recover and be discharged from the hospital without any residual bleeding or deficits from cardiac arrest. The importance of this case report is to provide interventional radiologists with a case demonstrating the Lazarus phenomenon in an angiography suite.

The case we have just described is unique owing to the placement of embolization coil just prior to the loss of cardiopulmonary function. One must be mindful of the occurrence of delayed ROSC, and consensus among the medical team must be achieved for pronouncement of death. The importance of CPR cannot be overstated, but in the presence of acute GI bleeding, resuscitation can lead to further extravasation.

Conflicts of interest

All contributing authors disclose no conflict of interest.

References

1. Adhiyaman V, Adhiyaman S, Sundaram R. The Lazarus phenomenon. *J R Soc Med*. 2007;100:552–7.
2. Gondolesi G, Matsumoto C, Wayne M, Schwartz M. Post-traumatic pseudoaneurysm of the common hepatic artery with duodenal fistula. *HPB (Oxford)*. 2002;4:183–6.
3. Sankaran S, Walt AJ. The natural and unnatural history of pancreatic pseudocysts. *Br J Surg*. 1975;62:37–44.
4. Webber G, James J, Gustavson S, Olin J. Contemporary management of postcatheterization pseudoaneurysms. *Circulation*. 2007;115:2666–74.
5. Morrison L, Kierzek G, Diekema D, Sayre M, Silvers S, Idris A, et al. Part 3. Ethics: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2010;122:665–75.
6. Agrawal G, Johnson P, Fishman E. Splenic artery aneurysms and pseudoaneurysms: clinical distinctions and CT appearances. *Am J Roentgenol*. 2006;188:992–9.
7. Lenartova M, Tahir T. Iatrogenic pseudoaneurysm of femoral artery: case report and literature review. *Clin Med Res*. 2003;1:243–7.
8. Liss P, Eklof H, Hellberg O, Hagg A, Bostrom-Ardin A, Lofberg AM, et al. Renal effects of CO_2 and iodinated contrast media in patients undergoing renovascular intervention: a prospective, randomized study. *J Vasc Interv Radiol*. 2005;16:57.
9. Cho K, Hawkins I. Carbon dioxide angiography: principles, techniques, and practices. New York: Informa Healthcare; 2007, Print.